

## A REMARKABLE AMANITA<sup>1</sup>

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(WITH EIGHT FIGURES)

During the autumn of 1908 I received from Mrs. VIRGINIA GARLAND BALLEEN, of Brookdale, Santa Cruz Co., Cal., a number of specimens of an *Amanita* which presents several remarkable peculiarities in its development and environic relations. For several years Mrs. BALLEEN has observed this *Amanita* and has made a careful field study of the more salient features of its development. This account of the fungus is based on fresh specimens and photographs which she has sent me, and upon her notes and descriptions, which show a remarkable appreciation on her part of the important morphological characters, as well as of important features of development.

This plant grows in the mountain forests of California. It is among the largest species of *Amanita*, the cap being 10 to 22<sup>cm</sup> in diameter, one of the larger ones, according to Mrs. BALLEEN, being sufficient for a meal. It thus rivals in size the royal *Amanita* of Europe, which it surpasses in robustness, though not possessing its rich orange-yellow color, and not attaining the height of the larger specimens of that species. It is interesting to note that the stocky character of this plant with its short stem is probably an expression of one of its environic and seasonal relations. It occurs in the high Sierras and in the Coast Range. Probably the entire summer season is needed for the growth and extension of the mycelium in the forest mold, so that the huge fruit bodies are developed in late autumn and early spring. While we have as yet no information bearing on the time of origin of the fundament of the fruit bodies, it is likely that all of them are formed during the summer and late autumn, and that the second crop, which appears early in the spring, is composed of plants which have lived through the winter in a partially developed condition. The autumn crop ceases about the last of December, while the spring crop begins about the middle of March.

<sup>1</sup> Contribution from the Department of Botany, Cornell University, No. 135.



In the high Sierras, where it is colder, the plant is well protected from frost injury, since it rarely if ever appears above the carpet of leaves covering the forest floor. Here it grows about the pines and firs. It has here almost become a subterranean fungus, a remarkable

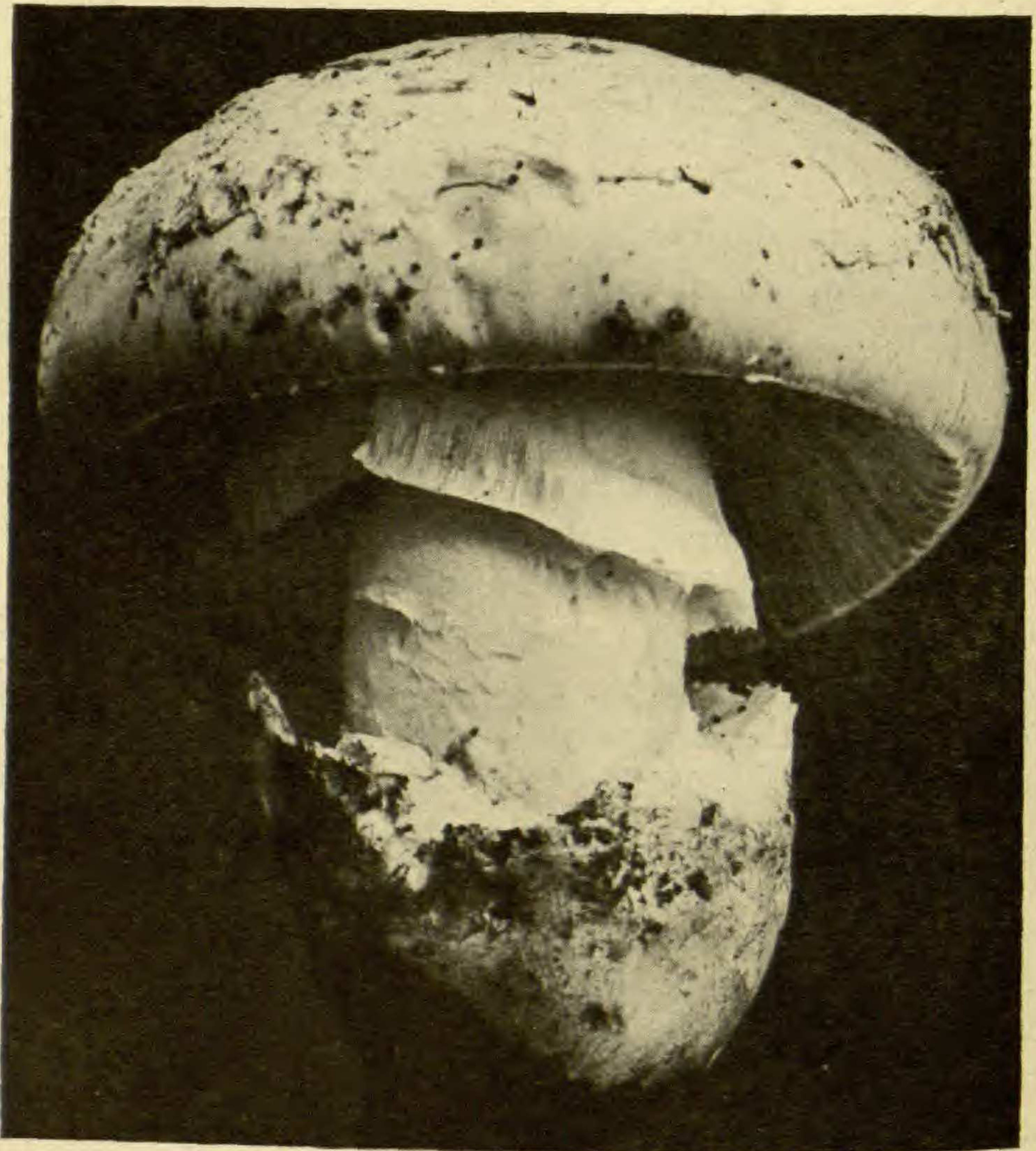


FIG. 1.—Partly expanded plant, showing calyptra of volva closely adhering to the pileus, the veil with the floccose remnants of the fundamental tissue between it and the stem, and the limb of the volva at base of stem.

thing for an Amanita. Thus it is difficult to find, the only evidence of its presence being the mounds of conifer needles which the hidden plants raise above them. Uncovering these and removing the plant there is a large cone-shaped hole in the soil made by the pressure of the very thick stem and cap. They are often found in bitter cold



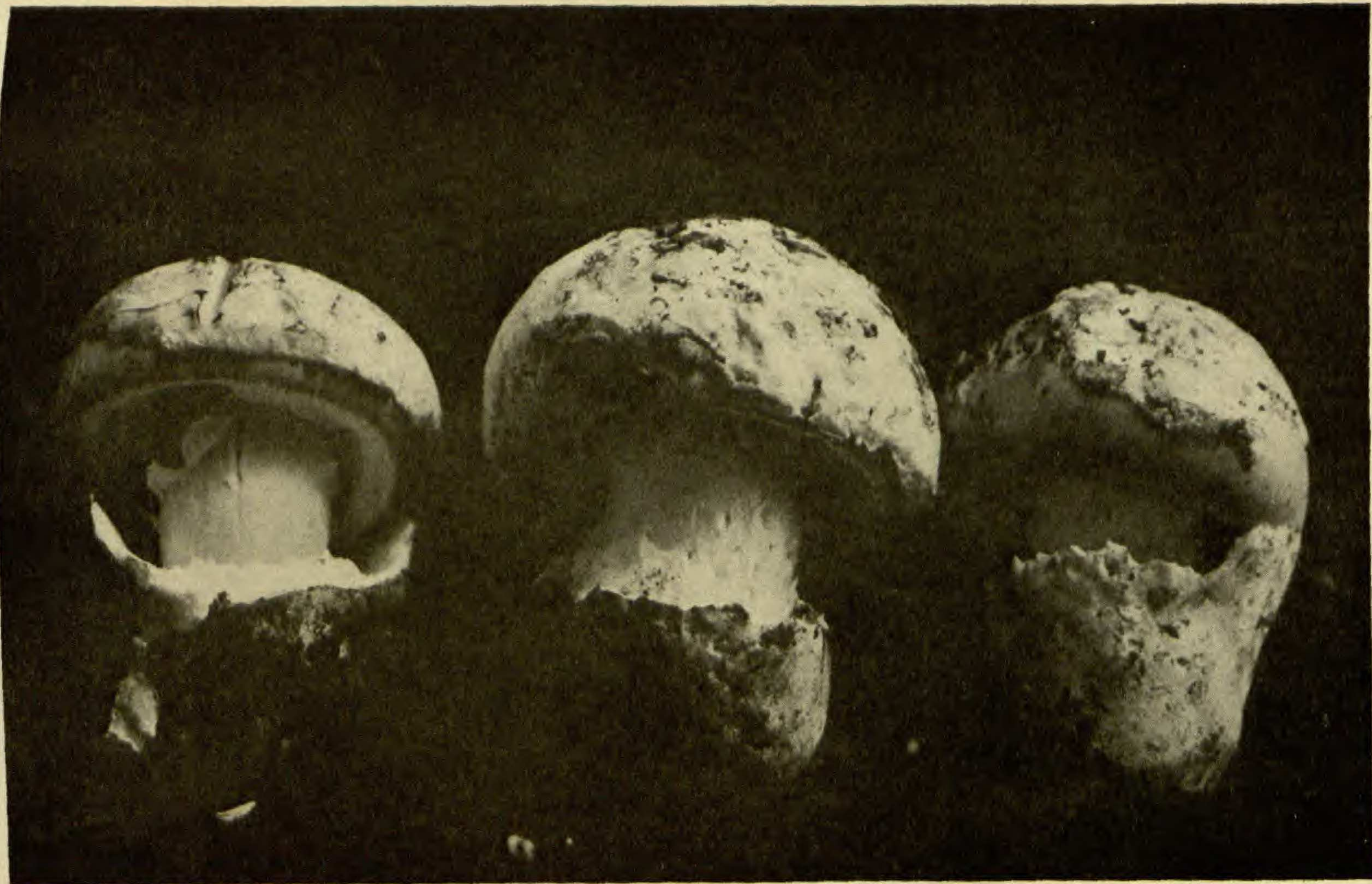


FIG. 2.—Three plants showing circumscissile dehiscence of the volva; the plant at the left with the delicate veil torn and (in front) the inner collar of the volva.



weather, when the ground is covered with snow, but are so well protected by the covering of needles and snow that they are perfectly fresh and uninjured, while a few hours' exposure to the air results in their being frozen. In the Coast Range they are smaller and not so

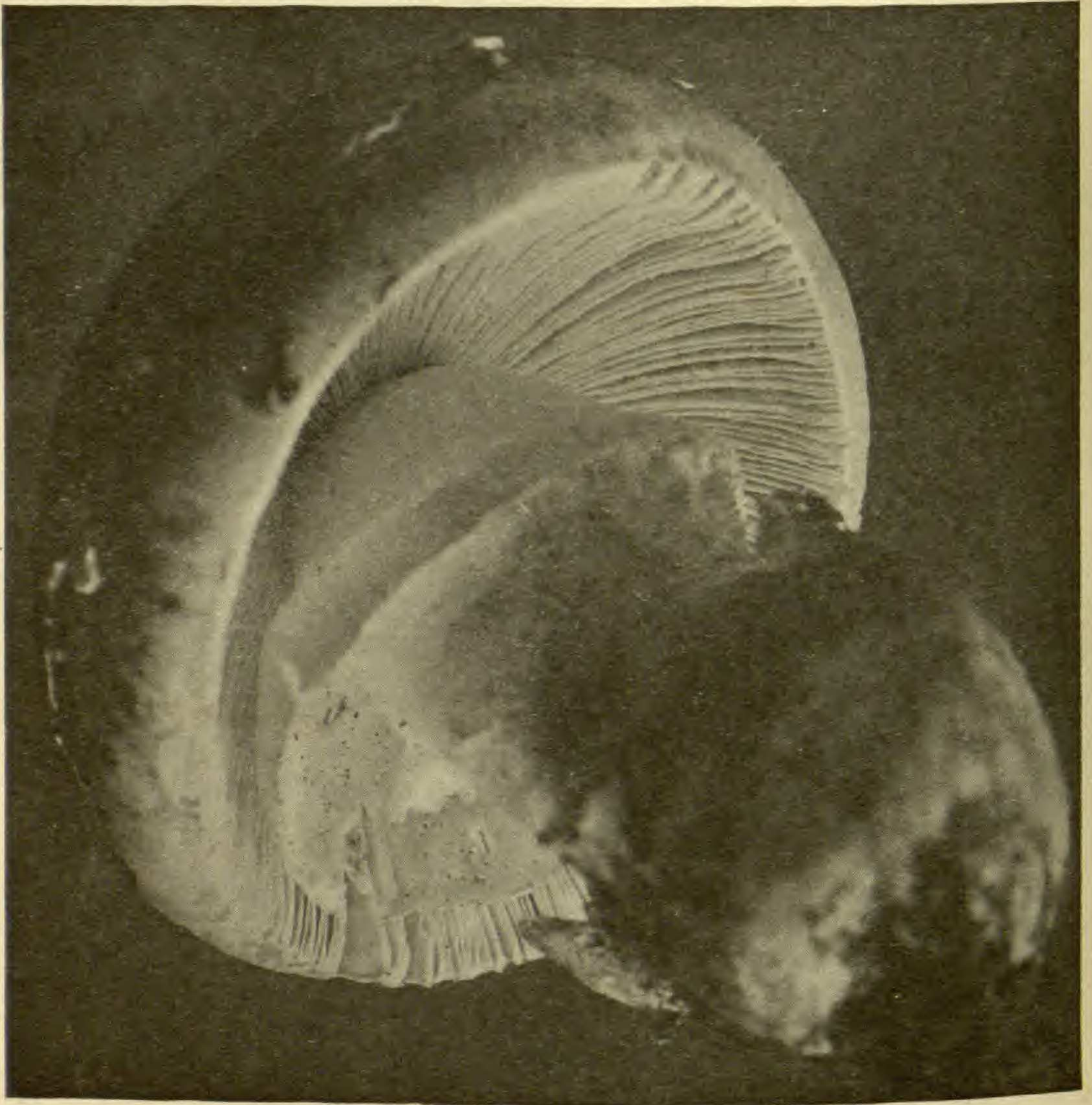


FIG. 3.—Partly expanded plant, showing veil attached at apex of stem and supported in a divergent position by the mass of loose cottony remnants of the fundamental tissue lying between the veil and stem.

bright-colored, and are found around the madroñas, chestnuts, oaks, pines, and spruces. Mrs. BALLEEN has never found them around the redwoods. The spring crop is also paler than the autumn crop. In the mountains about Brookdale, Santa Cruz Co., they appear above the ground.



The pileus is a maize-yellow in its bright-colored forms and varies to a pale straw color or Naples yellow (R.) in the vernal forms. The gills are at first white and later become tinged with the same color. The stem and inner veil or annulus are also tinged with pale straw

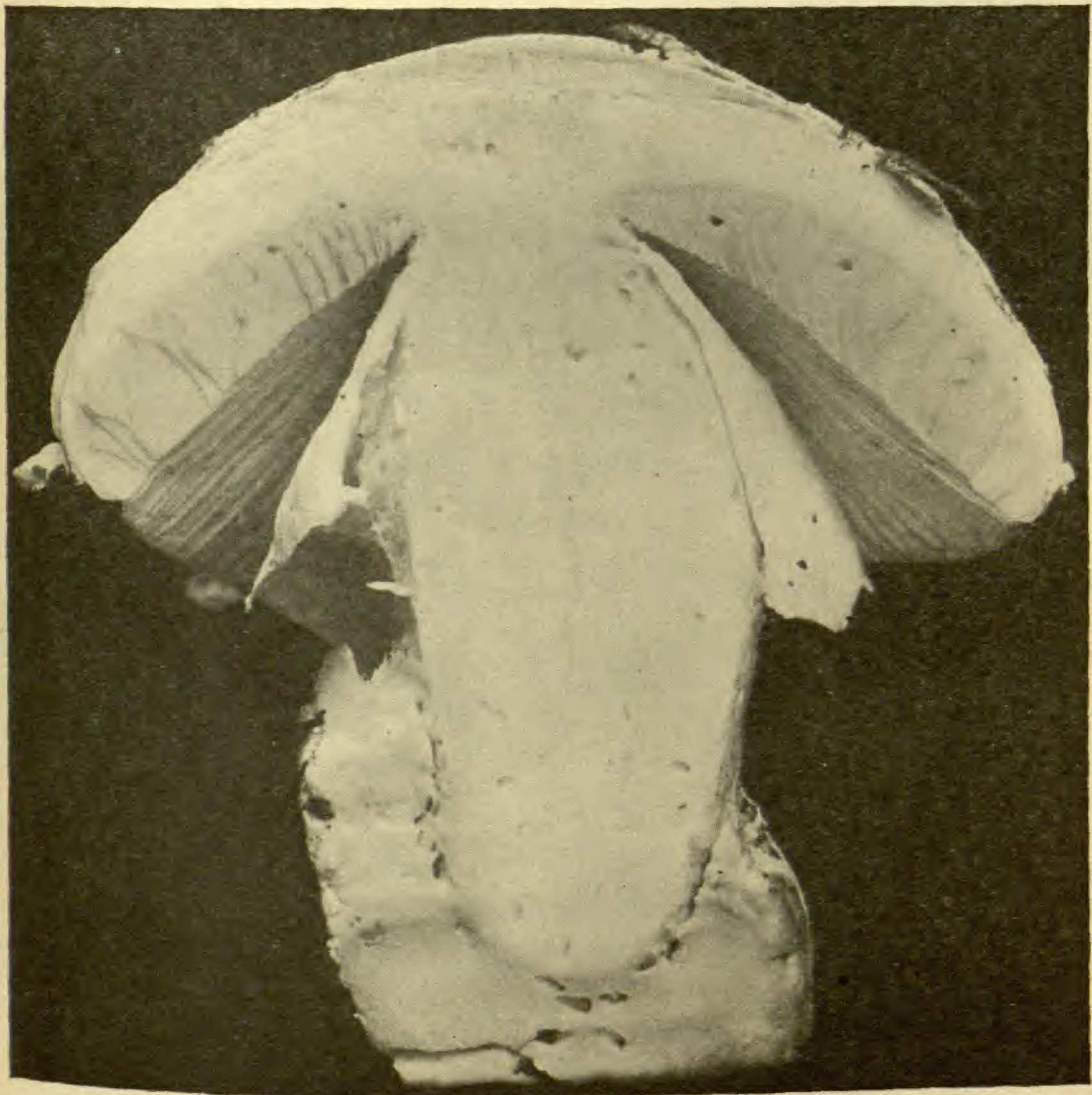


FIG. 4.—Section of plant showing pendent veil and loose cottony fundamental tissue between it and the stem.

color. The volva is thick, stout, and white, though in age it becomes more or less soiled and tinged with yellowish brown. The pileus is broadly rounded in the young plants, becoming broadly convex to plane, or in old plants the margin may become elevated, thus giving the pileus a depressed appearance.



Very little of the surface of the pileus is visible, since all except a narrow marginal portion is covered with the calyptra of the volva, which forms a thick, white, tough skin or covering, closely and tightly fitting the cuticle of the pileus. In cutting through the calyptra and pileus the line of junction can be seen, and in fresh plants this line of division is brought out distinctly because of the pale-yellow cuticle of the pileus. This calyptra, covering the larger part of the pileus like

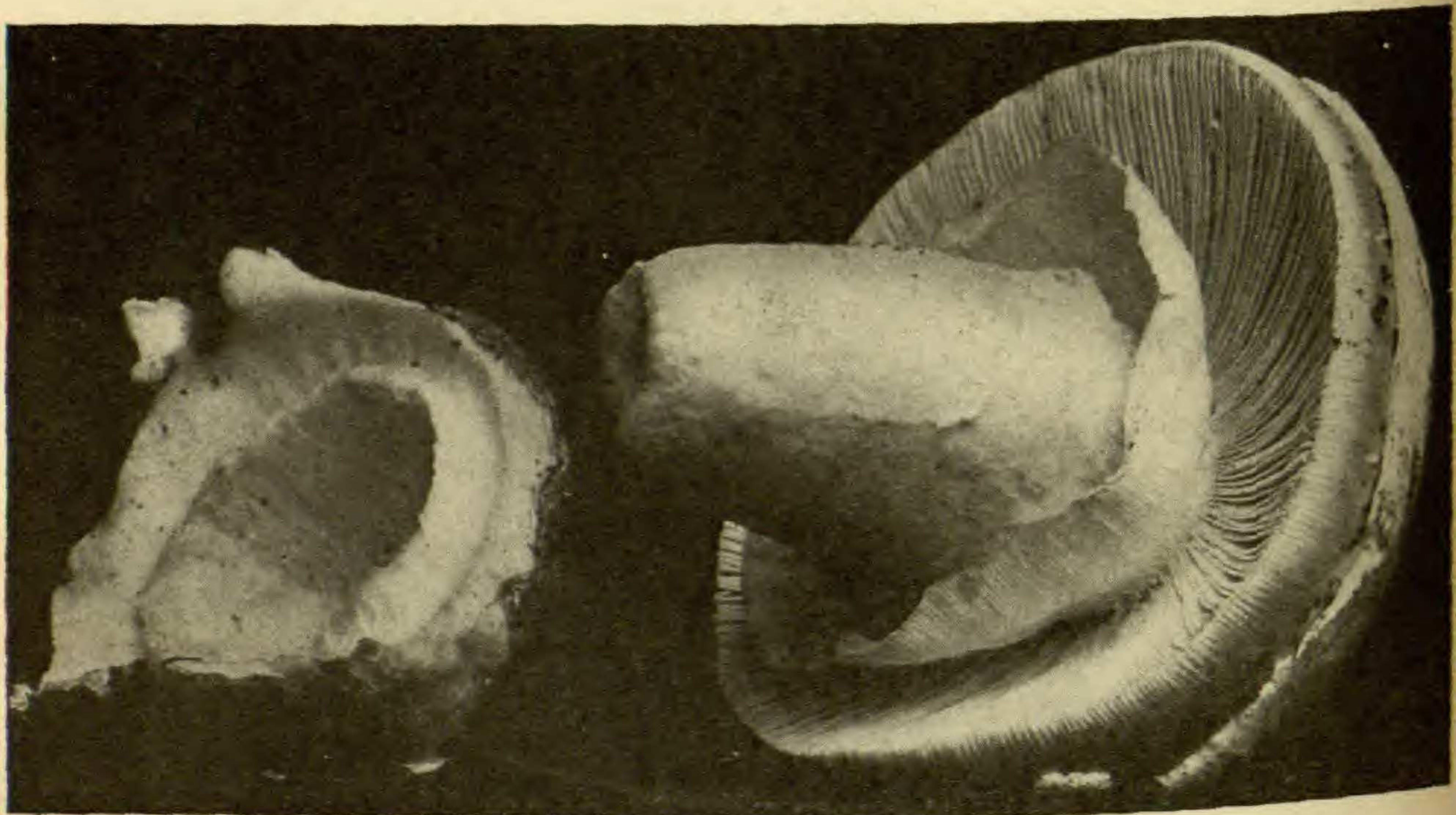


FIG. 5.—The stem separating from the volva; note inner collar of the volva, striate margin of the pileus, and very distinct thick calyptra.

a closely fitting cap, is often unbroken; but in large, well-expanded plants, it is often cracked into irregular large areas, as in *fig. 6*, showing the pileus between.

The inner veil is very thin and fragile, and disappears soon after the opening of the plant. When the plant is expanded the annulus is attached to the extreme upper end of the stem at the point of junction of the gills and stem, for the gills are adnexed, as in some other species of *Amanita*, and the stem is not readily separable from the pileus. The plant is very fleshy, is often attacked by larvae, and readily decays, so that transport of mature or nearly mature specimens is difficult.



In the button stage they sometimes carry and keep well for several days.

The inner veil is slightly connected with the edges of the gills and thus the expansion of the pileus produces a tension which tears the veil from the surface of the stem, with which it is also connected by

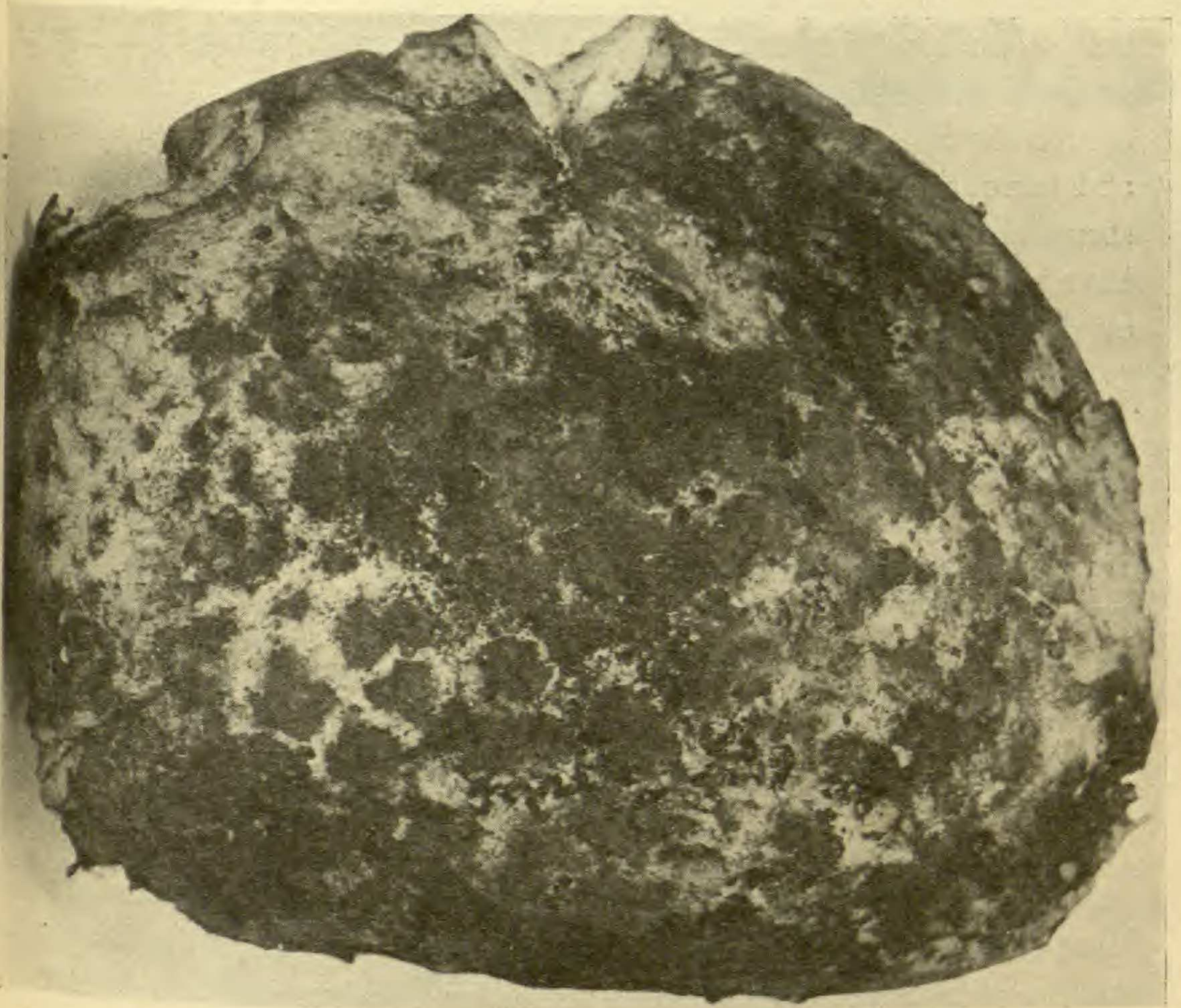


FIG. 6.—Surface of pileus, showing calyptra torn into large patches, which remain tightly adherent to the pileus.

remnants of the fundamental tissue. This tissue, lying between the veil and the stem, is very loose and floccose, so that it is torn into a delicate cottony mass, which often supports the veil in a divergent position as it hangs from the apex of the stem (*figs. 3, 4*). The veil itself is very delicate in texture, and Mrs. BALLEEN says that it "seems to melt away" soon after the expansion of the plant. This indicates that it is not well differentiated from the fundamental tissue. In



buttons which were shipped to me, and which opened in transit or after reaching here, this inner veil did not separate from the stem, but remained as fundamental tissue clothing the stem (*fig. 7*, where the outline of the cortex of the stem is shown within).

The stem is stout and comparatively short. The volva is circumscissile, but the lower half, which remains attached to the base of the stem, is large, with an ample, stout, free limb forming a large sac-like structure resembling that of the *Amanitas* with apical dehiscence, though the edge is more even. Within the basal portion of the volva and surrounding the stem there is often present a narrow collar or secondary sheath, the origin and nature of which, to my knowledge, have never been carefully described in any *Amanita*, for it is usually overlooked.

This inner collar or secondary sheath I have studied carefully in *Amanita caesarea* of Europe, while studying the higher fungi in the Jura Mountains of France, from specimens collected at Besançon and Arbois, in September, 1905. PLOWRIGHT<sup>2</sup> has called attention to a similar inner collar in specimens of *Amanitopsis spadicea*, and proposed to employ it in separating this species from *A. livida*, the two being usually brought together under this name, but he offered no suggestion as to its significance or origin. I have observed it and studied its origin also in *Amanitopsis livida* Richon & Roze and do not think that much specific importance can be attached to it, since it varies so in strength in different specimens and is often so obscure when it remains, as it sometimes does, closely applied against the base of the stem. Great credit, however, is due to Mrs. BALLEEN for having made such careful observations on the presence and nature of this interesting structure in the California *Amanita*, the more so since there is no published description of such a structure, and her observations, though later than mine on *Amanita caesarea* and *Amanitopsis livida*, were entirely independent of them, and made before she had called my attention to the existence of this species.

Longitudinal sections of the young plants when in the more advanced "egg" stage show all of the principal parts well formed. The pileus and stem when cut or bruised often turn a pale straw

<sup>2</sup> Trans. Brit. Mycol. Soc. 1897-8:40. See ATKINSON, Mushrooms, edible, poisonous, etc. 75. 1st ed. 1900, Ithaca. 2d ed. 1901, Ithaca, and 1903, New York.



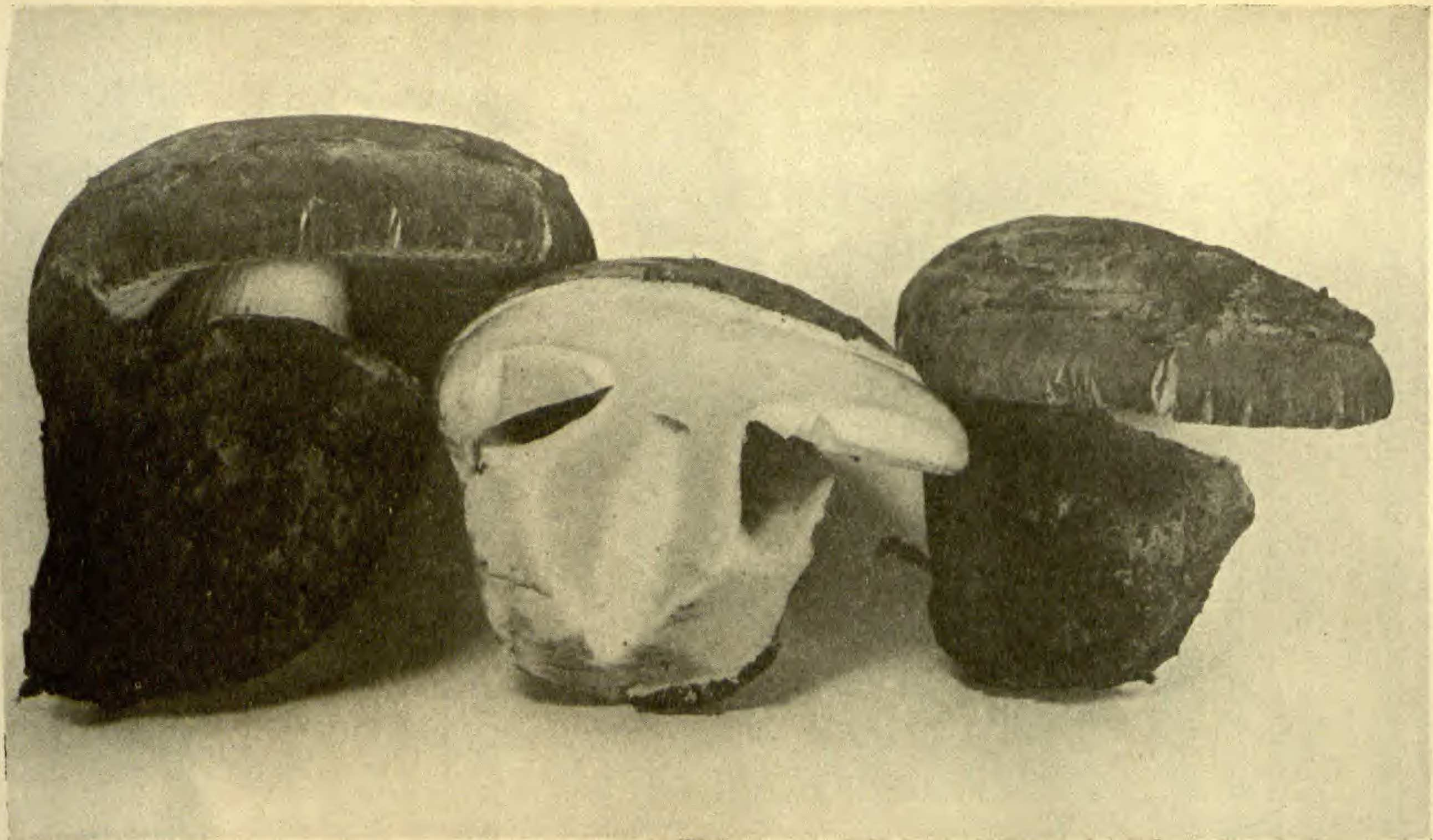


FIG. 7.—Plants photographed after transit from California to Ithaca, N. Y., showing dehiscence; middle plant in section, showing very distinctly the thickness of the calyptra; inner veil remaining attached to the stem and continuous below with the tissue that forms the collar on the inside of the volva, indicating that all of the tissue which lies between the stem and the gills is fundamental tissue.



yellow on exposure of the cut surface to the air. In such sections of young plants therefore the pileus is clearly marked off from the surrounding volva, and the wall of the stem is likewise marked off distinctly from the surrounding fundamental tissue. The gills are also well outlined. The slightly convex outline of their edge does not permit them to lie against the surface of the stem, and their lower or outer ends curve away from it in the young stage. This space is filled with fundamental tissue, and as the plant expands it is left free from



FIG. 8.—Photomicrograph of spores with Zeiss ocular 18, objective 3<sup>mm</sup>; object 370<sup>mm</sup> from plate-holder.

the stem and gills, but attached to the inner side of the base of the volva as a collar around the stem. When the plants become quite mature or old, there are tissue changes at the base of the stem inside of this collar which permits the stem to be very easily separated from the volva. By this time the free limb of the volva has recurved more or less, leaving the volva in the shape of a saucer with a recurved edge, and an inner collar. At this stage, if one takes hold of the cap to lift the plant, the stem is freed from the volva cup, leaving this saucer-shaped structure in the ground. *Fig. 5* is from a photograph of this stage, showing this saucer-like structure of the volva with its inner collar, and the freed stem at one side. In dry weather this separation of the stem from the volva does not take place.

I have proposed the name *Amanita calyptroderma* for this plant,



because the calyptra of the volva fits like a skin over the center of the pileus. Although a technical description has been published elsewhere,<sup>3</sup> it may be well to add a diagnosis here.

AMANITA CALYPTRODERMA Atkinson & Ballen.<sup>4</sup>—Plants 10–15<sup>cm</sup> high, pileus 10–22<sup>cm</sup> broad, stem 2–4<sup>cm</sup> stout. Pileus maize-yellow to pale chrome-yellow, gills white, then pale maize to cream color, annulus and stem pale maize to cream color, volva white. Pileus stout, fleshy, convex to expanded and even depressed in age, margin striate, slightly viscid when moist, larger part of pileus covered with the tough thick calyptra of the volva which fits closely like a skin, the margin free, while in age in the larger plants the calyptra of the volva is cracked into rather large areas by the expansion of the pileus. Gills broad, adnexed, edge more or less floccose. Basidia 4-spored. Spores oval to elliptical, smooth, coarsely granular, 8–12 × 7–8  $\mu$ . Annulus very thin, membranaceous, superior, hanging from the extreme apex of the stem, soon disappearing. Stem hollow, with loose cottony threads, even in the smaller plants, tapering upward in the larger ones, or smaller at base, surface floccose. Volva white, thick, circumscissile, in dehiscence the upper part remaining on the center of the pileus, lower portion of limb very prominent, 2–4<sup>cm</sup> long, sometimes appressed on the stem, but usually distinctly divergent and in age recurved, often with a distinct inner collar near the base, in age the stem often separating from the volva, leaving the latter as a saucer-shaped structure with its inner collar in the ground.—Mountain forests, California, in late autumn and early spring, Mrs. Virginia Garland Ballen. Herb., Cornell Univ., no. 22620.

<sup>3</sup> Science N. S. 29:944. 1909.

<sup>4</sup> Closely related to *Amanita calyptrata* Peck, Bull. Torr. Bot. Club 27:14. 1909, but differs in color and other characters.